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FINAL CLOSE-OUT REPORT FY '02 - FY '05 DARPA agreement MDA 972-02-1-0018

The Robert C. Byrd Institute for Advanced Flexible Manufacturing (RCBI) is pleased to submit the final report for agreement MDA 972-02-1-0018 to the Defense Advanced Research Projects Agency (DARPA).

Introduction and Background

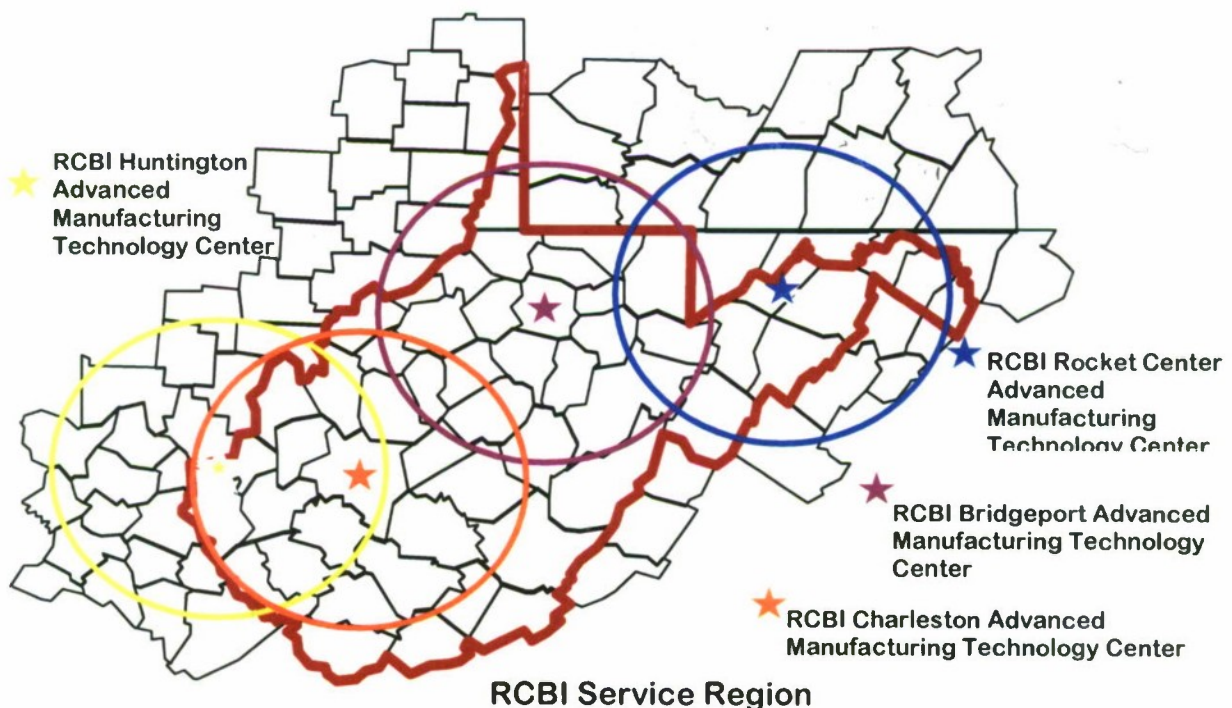
The mission of RCBI is to develop a capable, responsive and high quality manufacturing supplier base for the Department of Defense (DoD) and its commercial sector markets. This focused mission includes particular research & development activities on behalf of and with our manufacturing client base.

RCBI has worked with manufacturers across its service region to improve their manufacturing and operational practices. RCBI has introduced new technologies and provided technical training utilizing a variety of multi-media strategies as well as continued its well respected "hands-on" approach, shop-floor assistance and access to the latest computer-controlled manufacturing equipment. RCBI maintained direct contact with industrial developments, DoD agencies and their primes across the country to bring new approaches, applied research & development activities and technologies to manufacturers throughout our service region. Further, RCBI worked to build and encourage links among manufacturers across our service region, as well as ones with DoD offices and their primes that needed specialized manufacturing capacities; this effort encouraged mutually beneficial business interactions through effective networking and partnership opportunities.

RCBI worked to build linkages between manufacturers in our service region and DoD offices that have the need of a specialized manufacturing capacity. We also worked to bring the manufacturing base of our region together with major suppliers to the DoD.

Service Region

During the term of the grant, RCBI served all of West Virginia and portions of Pennsylvania, Maryland, Virginia, Kentucky and Ohio primarily from four West Virginia-based Advanced Manufacturing Technology Centers that are positioned to uniquely serve individual manufacturers in each region. However given RCBI's capabilities, its state-of-the-art service offerings have been completed in 17 states across the United States, including Alabama, California, Florida, Georgia, Illinois, Michigan, Mississippi, New Hampshire, New Jersey, North Carolina and Washington.



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Each RCBI Advanced Manufacturing Technology Center – located in Huntington, Charleston, Bridgeport and Rocket Center – defines a sub-region with a radius of approximately 60 to 100 miles from which RCBI principally draws manufacturing client companies. Each sub-region has a concentration of manufacturers with similar needs and markets; however, each sub-region maintains its own distinct industrial focus.

Accomplishments During the Period of the Grant

During the term of the grant, RCBI's dynamic, sharply focused, statewide service delivery system was fully operational and making a difference to the state's and region's manufacturers. RCBI served more than 5,000 manufacturers that employed 80,000 individuals across West Virginia and the surrounding region. In addition, RCBI has identified and served 450 regionally located companies that are quality certified and can and did deliver parts, components, on-time, quality-certified to the DoD and commercial primes. Each RCBI Advanced Manufacturing Technology Center is fully equipped with computer-controlled and production-ready equipment, applied research & development areas, state-of-the-art computer labs, manufacturing staff expertise, training resources, as well as video-teleconference capabilities that are available to our state's and region's manufacturers.

RCBI had a positive, measurable impact during the term of the grant. Activities of the Robert C. Byrd Institute for Advanced Flexible Manufacturing were directly responsible for bringing nearly 1,000 highly skilled and higher paying jobs to the region, translating into \$43 (M) million in incremental incomes. The average employee salary was roughly \$44,000 – nearly two-thirds more than the average West Virginian's salary. RCBI contributed either directly or indirectly to a \$312 (M) million increase in total output by West Virginia companies using its services.

The RCBI Huntington Advanced Manufacturing Technology Center served more than 4,100 manufacturers that employ nearly 71,000 individuals across its multi-state service region. The RCBI Huntington facility focused on the metals manufacturing, tool & die, and heavy-equipment parts production markets as well as provided reverse engineering assistance, CAD/CAM and other high end software engineering assistance.

Access to the latest advanced machining and development capabilities resulted in manufacturers expanding their competitive capabilities so they lowered their production costs, improved production efficiency, maintained tight tolerances and thus greatly controlled – and greatly enhanced – the quality of their products.

Specialized technologies and state-of-the-art and -market equipment available to private industry on a shared – or leased use – basis at RCBI Huntington included:

- Amada High Precision Hydraulic CNC Press Brake with 90-ton capacity
- Charmilles Technologies Robofil 440cc Submersible Wire EDM Center
- Mazak Integrex Mark 3 ST Multitasking Machine
- Okuma LU370BBM 4-axis CNC Turning Center with live tooling
- Amada Pulsar 1212XL 2000-watt Laser Cutter
- Mazak VCN-510 Vertical Machining Center
- Kitamura 7X Vertical Machining Center
- Starrett SPC Equipment
- Alpha Harrison 460 CNC/Manual Lathe
- Parlec Tool Presetter
- Stratasys FDM Rapid Prototype Machine
- Handyscan 3D Digital Laser Scanner
- FARO Arm CAM2 Measurement System
- Sheffield Measurement (Giddings & Lewis) Cordax Coordinate Measuring Machine
- HYD-MECH Programmable Horizontal Band Saw
- State-of-the-art videoconferencing equipment
- Clausing 15x50 Lathes

- Drake V-16 Vertical Band Saws
- Willis Big Bear 1100 Radial Drill Press
- Willis Model 1050 Manual Turret Mills
- Jafo FWF-32J Horizontal Mill
- HE&M Twister Horizontal Cut-off Saw
- Baldor 1021wd Pedestal Grinders
- Acer AGS 1020 ADH Surface Grinders
- Pentium Computer Lab

The RCBI Charleston Advanced Manufacturing Technology Center served more than 1,000 manufacturers that employed nearly 16,000 individuals. The Charleston facility focused on the metals manufacturing and fabrication, chemical production, and heavy-equipment parts production markets as well as provided a multitude of training opportunities on equipment controls, programming and software design.

Specialized technologies and state-of-the-art and -market equipment available to private industry on a shared – or leased use – basis at RCBI Charleston included:

- Fortus 3D Printer
- Fortus 900mc 3D production system for direct digital manufacturing and functional rapid prototyping, conceptual modeling and limited-rate production
- Star SR-20J Swiss Type CNC Machining Center
- Flow International 4 X 8 Flying Bridge CNC Abrasive Water-jet Dynamic Cutting System
- Okuma MX-60HB Horizontal Machining Center
- Okuma LU15 CNC Turning Center
- Okuma MA-650 CNC Vertical Machining Center
- Haas TL-3 CNC/Manual Lathe
- Handyscan 3D Digital Laser Scanner
- Starrett SPC Equipment
- Bridgeport Series 1 Mill
- Willis 15x50 Lathes
- HE&M Twister Horizontal Cut-off Saw
- Baldor 1021wd Pedestal Grinders
- State-of-the-art videoconferencing equipment
- Pentium Computer Lab

The RCBI Bridgeport Advanced Manufacturing Technology Centers, focused on both metals and composites, served nearly 800 manufacturers and worked with more than 16,500 employers and employees in the aerospace community. The RCBI Bridgeport facility focused on aerospace, aeronautics and other commercial and defense markets. Specialized technologies were added to enhance the growing industrial base across the region and were the catalyst for the region's companies to develop new products and processes as well as secure and maintain contracts with both NASA and the DoD. RCBI became recognized as a national leader in specialized technologies and composites-sector offerings through efforts including establishment of the RCBI Composites Technology & Training Center.

Occupying an approximate 27,500-square-foot facility in the Harrison-Marion Regional Airport's Benedum Industrial Park, RCBI Bridgeport provided service to neighbors and clients that included Bombardier Services, Northrop Grumman, Pratt-Whitney, Aurora Flight Sciences, Boeing, Lockheed Martin and FMW Composite Systems Inc., to name a few manufacturers.

RCBI operated separate metals-oriented (DARPA-sponsored) and composites-oriented (NASA-sponsored) centers in Bridgeport. During this period management worked to integrate the centers into a single organization, with the objective of improved coordination and enhanced service levels for client companies.

Specialized technologies and state-of-the-art and -market equipment available to private industry on a shared – or leased use – basis at RCBI Bridgeport included:

- **Fryer Easy Turn 30 CNC Lathe with Steady Rest and Following Rest**
Designed to satisfy machinists' needs, the Easy Turn represents high quality and value with trouble free use. This model is easier to use than a conventional lathe, and offers the productivity of a CNC lathe. Time consuming manual set-ups are eliminated by its handle-driven "Do-One" cycles and electronic stops.
- **Metal Disintegrator**
This equipment offers the ability of disintegrating and removing broken tooling, studs, taps (up to 1.25"), and drills without damaging the internal hole in the part.
- **Cincinnati Machine Hawk CNC Turning Center**
The Cincinnati "Hawk" features a 12-station quick-change tooling turret and sits in a smaller "footprint" on the shop floor, in contrast with comparable lathes. It is fitted with a 3 ½ inch hole through spindle and a 12 inch chuck. It can handle parts up to 44 inches in length.
- **Cincinnati U5 6-axis CNC Machining Center**
The 6-axis served the aerospace industry's need for oversized and exotic parts production. These abilities enabled manufacturers to bid jobs they otherwise might have to pass up due to the size and productivity limitations of lesser technology. An investment to expand the 5-axis machining center, by adding a rotating table for sixth-axis positioning and a highly specified Siemens control, RCBI as the only one of its kind, readily available, manufacturers' resource shared on the East Coast.
- **Okuma MX-55VB CNC Vertical Machining Centers**
- **Okuma Crown CNC Turning Centers**
- **Starrett SPC System**
- **Bridgeport-type Series 1 Mills**
- **State-of-the-art videoconferencing equipment**
- **Pentium Computer Lab**
- **Bondtech Composite Autoclave with Programmable Chart Recorder and paperless recorder capable of 600 degrees F and 200 PSI**
- **Clean Air Technology "Softwall" Cleanroom**
Earned the designation as surpassing standards for an ISO 14644-1 and ISO 14644-2 Class 6 clean zone/Fed Standard 209E Class 1000.
- **Handyscan 3D Digital Laser Scanner**
- **Matec Non-destructive Testing (NDT) Equipment**
Non-destructive Testing equipment available in RCBI's Metrology lab, which served the aerospace, aeronautics, ordinance, transportation, construction, chemical, petrochemical, energy, composite tooling, safety glass and metallurgical industries, performed non-destructive analysis of the structure and composition of the material to detect anomalies.
- **The McClean Anderson WSH Flex Filament Winder**
The WSH offered computer-controlled motion and employs all-digital AC servo technology. The WSH is driven by powerful Windows®-based *flexwind* machine control and Composite Designer pattern development software and is well optioned to meet manufacturers' specific winding requirements to serve industries ranging from DoD aerospace and munitions requirements to commercial automotive and athletics markets.
- **Coordinate Measuring Machine (CMM)**
The CMM offered dimensional testing and reverse engineering when older parts needed to be replaced. By improving inspection abilities from those obtained from hand tools and reducing the time

involved in the process, CMMs ensure the quality of a product for manufacturers and reduce scrap rates.

- **Matec Ultrasonic Immersion System**
Immersion tank systems are extremely flexible and adaptable ultrasonic testing systems designed to inspect a diverse range of components for industry.
- **Nondestructive Ultrasonic Squirter System**
The ultrasonic squirter system is used to perform non-destructive evaluation of the structure and composition of parts to detect subsurface anomalies using ultrasonic testing techniques to ensure the quality of the part.
- **FARO Arm CAM2 Measurement System**
- **Leica Q5001W Imaging Workstation**
- **Northwood 5-axis CNC Router**
This versatile, high speed machine offers manufacturers flexibility in programming and is especially useful in the aerospace, composites, plastics and woodworking sectors.
- **Flow International Flying Bridge CNC Abrasive Water-jet Cutting System**
- **Precision Quincy Corp. Curing Oven**
- **Cutting Room**
- **Laser Tracker**
- **Laser Scanner**
- **Real-time X-Ray**
- **Downdraft Benches**
- **HP Designjet 750C Plus Color Plotter**
- **Willis 15x50 Lathes**
- **Drake V-16 Vertical Band Saw**
- **Willis Big Bear 1100 Radial Drill Press**
- **Jafo FWF-32J Horizontal Mill**
- **HE&M Twister Horizontal Cut-off Saw**
- **Baldor 1021wd Pedestal Grinder**

The RCBI Rocket Center Advanced Manufacturing Technology Center, in the eastern hills of West Virginia on the site of a Navy Co-op with Allegheny Ballistics Laboratory's West Virginia operations, serves as a very specialized training arm of RCBI, housing particular technologies focused on preparing the workforce for specific, just-in-time DoD contract opportunities. Training focused on computer-controlled skills as well as specialized, customized machinist skills to meet specific contract requirements.

Specialized technologies and state-of-the-art and -market equipment available to private industry on a shared – or leased use – basis at RCBI Rocket Center included:

- **The Haas TM-2 Toolroom Machining Center**
The TM-2 features the new Haas Intuitive Milling System software. It is extremely easy to set up and operate, even if operator doesn't know G-code programming. For extreme flexibility, it operates in three modes: manual, combined manual/CNC and full CNC.
- **Alpha Harrison 460 Plus CNC/Manual Lathe**
The "460 Plus" offers manufacturers the ability to allow an operator, untrained on CNC equipment, to gradually transition his/her abilities to full CNC abilities, while more easily operating the controls of the lathe.
- **American Autoclave with paperless recorder**
- **Handyscan 3D Digital Laser Scanner**

- Instron Materials Testing Instrument Model 5582
- Bridgeport-type Series 1 Mills
- Willis 15x50 Lathes
- Drake V-16 Vertical Band Saw
- Baldor 1021wd Pedestal Grinder
- State-of-the-art videoconferencing equipment
- Pentium Computer Lab

Staff Expertise

During the term of the grant, RCBI built a strong, capable staff oriented to delivery of services to manufacturers across its service region. The collective backgrounds of individuals at RCBI bring both standard machining, prototyping and CNC machining expertise; CAD/CAM expertise; SolidWorks, Inventor, and AutoCAD and Autodesk; Automotive Technology, including ASE Master Automobile Technician and ASE Engine Assembly Specialist certification; process improvement; supply chain management; plant management experience; Master Electrician; CNC process management and programming; NC Machine tool engineering and supervising; diagnostic equipment and maintenance; MIG, TIG and ARC welding; Non-destructive Testing inspection; electrical design specialty; Esprit, FeatureCam, Mastercam, SurfCAM and Autodesk AutoCAD software expertise; process/manufacturing engineering in composites structures; PLC programming; IEC and NEC print experience; Quality; ISO; Lean; Software Skills; Technical Education Counseling; Electrical; PLC; robotics programming; and IT expertise including CCNA, CCDA, CCNP, Network +, IP Telephony, Wireless LAN specialists, MCP, BICSI, Microsoft, Cisco, Novell, Linux and Dell to the manufacturing sector across the RCBI service region.

To include the growing needs of industry, RCBI staff members have industry-based composites-materials experience that includes fabrication, mold making, bonding and repair for client project activities and training purposes; the ability to assist in development of composites training materials and hands-on projects; knowledge of Non-Destructive Testing (NDT) methods, Reverse Engineering and CMM use; knowledge of Geometric Dimensioning & Tolerancing (GD&T); Federal Aviation Administration (FAA) Aircraft and Power Plant inspection and certification; the ability to provide both formal classroom and On-The-Job Training (OJT); knowledge of manufacturing software (CAD - Pro/E, CNC Programming, Mechanical Desktop, Solid Edge, CAM – SurfCAM, Mastercam, Virtual Gibbs), adhesive bonding of composites and Quality Assurance; knowledge of Environmental Management Systems Standards; ability to read blueprints and interpret drawings; skill in design/fabrication of composites tooling, and knowledge and experience with continuous improvement tools and methods.

RCBI's broad and deep expertise, which during the term of this grant was available to manufacturers 24 hours a day every single day of the year, represents more than 600 years of industrial experience. RCBI directly employs 39 individuals – a number that quickly rises to more than 70 with subcontractors (who are supported by client fees).

In addition to internal staff expertise, RCBI partnered with various organizations to accomplish a variety of tasks. Partners included:

NATIONAL

- U.S. Navy
- Office of Naval Research
- Defense Logistics Agency
- NASA Langley Research Center
- NASA Goddard Space Flight Center
- Man Tech International
- Lockheed Martin
- Lockheed Martin Skunk Works
- Boeing

STATE

- State of West Virginia
- the Region's Business Community
- Marshall University
- Marshall Community & Technical College (MCTC)
- West Virginia Development Authorities
- West Virginia Manufacturers Association
- West Virginia Chambers of Commerce
- Polymer Alliance Zone
- Potomac State College of WVU

- The Composites Manufacturing Technology Center - the Navy Center of Excellence for Composites Manufacturing Technology
- National Composite Consortium (NCC)
- Western Governors Association
- The 130th Airlift Wing of the Air National Guard
- National Association of Manufacturers (NAM)
- Virtual Parts Supply Base (VPSB)
- National Technological University
- Orbital Science Corporation
- American Composites Manufacturers Association (ACMA)
- Online Quotes from www.mfgquote.com
- Society of Manufacturing Engineers
- Distance learning from ToolingU.com
- Zane State College
- West Virginia Northern Community College
- West Virginia University (WVU)
- West Virginia vocational-technical centers
- WVU Institute of Technology
- Allegany Co. (MD) Career Center
- Mine Safety and Health Administration
- UMWA
- West Virginia Development Office
- Dow Chemical

Service Units

RCBI's internal structure provided fully integrated, complete manufacturing technology offerings to small and medium-sized manufacturers across a statewide, four-site system on-site 24-hours-a-day/7-days-a-week. As detailed throughout this close-out report, the various service units complement each other and combine efforts whenever needed to serve client companies effectively.

Technical Services offered specialized, state-of-the-art, manufacturing equipment, programming, prototyping as well as a host of other related offerings, available at RCBI Advanced Manufacturing Technology Centers, and had nearly 500 years of hands-on equipment-related manufacturing experience, delivered customized and general technical, administered all technology transfer projects. During the term of this grant, each site was managed on a daily basis by senior manufacturing engineers and further staffed with manufacturing technicians, quality specialists, safety specialists, systems integration staff, as well as other focused and pertinent individuals.

The RCBI Technical Services group offered companies specialized technologies to deliver contracts by leasing time on state-of-the-art production equipment while simultaneously providing the latest training and programming assistance to employees. Technical Services introduced specialized technologies and just-in-time manufacturing processes, and served as a catalyst for industrial development and contract delivery. Technical Services made it possible for manufacturers of all sizes to fulfill contract requirements including specific requirements, tolerance specifications, just-in-time mandates, as well as provided training, leased time on equipment, offered programming assistance and set-ups to ensure quality driven components for projects including the Global Hawk UAV and its V-tail Aft Composites Wing section. A specific project that demonstrates the technical aspects of services at RCBI involved space shuttle needs for the nation's space program. A West Virginia manufacturer received an R & D opportunity to design, develop and produce a prototype Super Light Weight Interchangeable Carrier (SLIC) pallet through a multi-phase contract. As a direct result of RCBI assistance and access to its service offerings – including access to computer-controlled equipment, technical training and quality assistance – this manufacturer delivered on this series of contracts worth in excess of \$18 (M) million.

With integration of metals and composites-manufacturing technology and training assistance, RCBI achieved the objective of improved coordination and enhanced service levels for client companies. Further, this focus resulted in RCBI providing additional services to all of West Virginia, the Mid-Atlantic states of Pennsylvania, New Jersey, Delaware and Connecticut as well as the Gulf states of Alabama, Florida, Georgia and Mississippi.

The integration of metals and composites-manufacturing equipment resulted in more technology for manufacturers and included:

- Browne & Sharpe TORO Runway FB2 Model 60.16.21 Coordinate Measurement Machine with PC-DMIS Pro Metrology software
- Flow International I-4800 Integrated Flying Bridge Abrasive Water-jet Cutting System
- Bondtech Composite Autoclave with Programmable Chart Recorder and paperless recorder capable of 600 degrees F and 200 PSI
- Quincy Corp. Curing Oven
- Clean Air Technology "Softwall" Cleanroom
- Matec Non-destructive Testing (NDT) Ultrasonic Immersion Inspection Equipment
- Matec Non-destructive Testing (NDT) Ultrasonic Squirter Inspection System
- Real-time X-Ray
- Cutting Room
- Northwood 5-axis CNC Router
- McClean Anderson WSH Flex Filament Winder
- Tinius Olsen H100K-S Benchtop Universal Material (Tension) Testing Machine
- Sheffield RS150 Coordinate Measurement Machine
- FARO Arm CAM2 Measurement System
- FARO Laser Tracker
- Handyscan 3D Digital Laser Scanner
- Omega Digital Anemometer

The RCBI Technical Services group provided technical assistance to nearly 4,000 companies that ranged in size from two (2) employees to 1100 employees. One-hundred-twenty-three (123) manufacturing companies received technical assistance at RCBI to meet their programming, product development and production requirements.

TECHNOLOGY TRANSFER

As a direct result of exposure and trial use of RCBI's specialized, computer-controlled, production equipment and state-of-the-art technologies, more than 180 pieces of CNC equipment at a value exceeding \$26 (M) million were acquired by private industry in the region served by RCBI. RCBI scheduled seminars attended by national machine tool representatives from equipment vendors as well as our own technical staff members in an effort to demonstrate hardware and software capabilities to local manufacturers. These seminars resulted in exposure to the latest, specialized computer-controlled, production equipment available at RCBI for leased use. RCBI partnered with national tool vendors including Blue Ridge Machinery and Tools, FARO Technologies, Kennametal, Kyocera, Mastercam, Okuma, Sandvik Coromant, SECO Carbology, Stratasys and Sterling Supply (among others) to bring the latest technologies to the state and region.

During the term of this grant, RCBI was able to boast the success of a first NASA technology transfer and commercialization in the Mid-Atlantic states' region that benefited private industry. This success was the result of concentrated efforts by RCBI to form partnerships and collaborations between private industry participants, the NTTC and the NASA Langley Research Center to bring high-level prototype technology testing to West Virginia. With use of this high-level catalyst technology -- Low Temperature Oxidation Catalyst Technology Formaldehyde abatement -- industries in West Virginia focused on chemicals, composites, automotive and wood/fiber were able to reduce emissions and expand their operations and markets. RCBI's private industry partner identified 20 manufacturing plants across the region that had a potential interest in installation of this technology at their facilities to comply with EPA regulations. A prototype of this effort is continuing to be developed, and is expected to reduce formaldehyde emissions, create jobs and expand the manufacturing base.

RCBI worked closely with companies participating in the RCBI 21ST Century Manufacturing Network (www.21stmanufacturing.org) to identify and provide quality manufacturing options to the new hydrogen fuel production plant and vehicle fueling station at the Yeager Airport in Charleston, W.Va. This U.S. Department of Energy energy-prototype project involved the construction and operation phase of the

hydrogen production plant. From a small, automated production plant like the one envisioned at Yeager Airport, hydrogen fuel can be produced for the equivalent of about \$2.10 a gallon at conventional gasoline prices. The Yeager-based 130th Airlift Wing of the Air National Guard is receiving several hydrogen-burning vehicles as a component of this energy project.

Workforce Development and Technical Training directs efforts to educate and train individuals so their technical abilities were fully developed to meet manufacturers' demands. Technical course offerings were tailored to meet manufacturers' individual needs in areas ranging from basic blueprint reading to introductory and advanced CNC machining on specialized technologies including a Fortus 3D production system for direct digital manufacturing and functional rapid prototyping, conceptual modeling and limited-rate production; an Integrex multitasking machine, a Mazak machining center, a laser cutter, a water-jet cutter, a Fryer Easy Turn lathe; a 6-axis machining center and a "Swiss Turn." Programmable Logic Controller (PLC), CAD/CAM, Programming, Electrical, and Safety issues training have also been customized and presented to manufacturers across the RCBI service region. RCBI has provided customized technical training to nearly 4,000 companies that ranged in size from two (2) employees to nearly 1,500 employees. Nearly 7,000 individuals representing 120 companies received customized technical training assistance from RCBI.

WORKFORCE DEVELOPMENT

During the term of this grant, RCBI developed and initiated the nationally certified RCBI Machinist Technology Program. This "teaching factory of the future" – certified by the National Institute for Metalworking Skills (NIMS) – is ongoing at the RCBI Advanced Manufacturing Technology Centers in Huntington, Bridgeport and Rocket Center. Each facility has earned individual certification from NIMS. Several courses in the Machinist Technology Program are taught through distance learning and simulations. Two-hundred-seventy (270) individuals had completed hands-on coursework in the Machinist Technology Program at the statewide Advanced Manufacturing Technology Centers. These individuals had entered the work force earning wages that ranged from \$10 an hour to \$16 an hour with benefits. This successful program boasts a 94 percent industry placement rate and a 100 percent career advancement rate for its graduates. Each individual who completes the program is required to earn individual credentials in at least three (3) of seven (7) machining skill-sets categories set by NIMS; the 270 graduates earned 1,100 individual credentials from NIMS. The RCBI program is the only one in the nation that couples its machinist certification with a two-year college degree opportunity. One-hundred-nineteen (119) of the program's graduates earned Associate degrees; others are in the process through their local community colleges. The training program produced nationally (NIMS) certified machinists for immediate employment in the region's industrial base, minimized the amount of re-training required after initial employment, and created a pool of technically talented individuals for the manufacturing sector. An 11-member Industry Advisory Board advises the RCBI Machinist Technology Program.

The focused machinist training continues to be available in both full- and part-time options at three of RCBI's statewide facilities; it was customized and delivered in part-time scheduling for manufacturers in two shifts in Bridgeport, as it has been for other manufacturers at other RCBI facilities as needed. More in-depth CNC coursework has been added to the curriculum. RCBI expanded the machinist training program to reach the western portion of Pennsylvania, northern region of West Virginia and eastern portion of Ohio through a partnership with the West Virginia Northern Community and Technical College and the Park Vocational-Technical Training Center at Wheeling Park High School. RCBI provides the instructor and the NIMS-certified curriculum and the partners provide the facilities and equipment.

Because of its proven success, the RCBI Machinist Technology Program offers exactly the type of training program that can serve as a model training resource for organizations that wish to incorporate a degree option with NIMS credentialing. This is the finding of NIMS, which has referred RCBI as a model to replicate to several community colleges across the nation that wish to integrate their offerings with nationally recognized NIMS credentialing. Shoreline Community College near Seattle, Washington and Clark College in Vancouver, Washington, to name a couple, are in the process of visiting the RCBI program.

RCBI's expansion plans included introduction of a full-time CNC Specialist Program, modeled after the award-winning Machinist Technology Program and introduced in response to the nationwide shortage of qualified CNC machinists. Participants who complete it will be eligible to earn individual credentials determined by NIMS, simultaneous with an Associate degree.

RCBI demonstrated success in conducting multiple customized training programs utilizing skills assessment tools, developing company specific training schedules, and providing full level implementation.

During the period of the grant-term, RCBI provided advanced composites training to meet requirements of NASA Servicing Engineers. This activity expanded RCBI service outreach to the Baltimore and the greater DC metropolitan areas and fills a skilled workforce deficiency along the East Coast.

The NASA Goddard Space Flight Center in Greenbelt, Md., contracted with RCBI to support developmental requirement projects including the two-stage Crew Exploration Vehicle/Crew Launch Vehicle (CEV/CLV). Both CEV and CLV are key elements of NASA's detailed plan to support sustained human and robotic lunar exploration operations for missions to the International Space Station, among others. RCBI also successfully completed various levels of composites training at the Marshall Space Flight Center. RCBI also provided composite machining training to NASA Goddard.

RCBI is preparing to implement a national curriculum for future National Certification in Advanced Composites for Technicians. This training will enhance all levels of the composites-manufacturing workforce. RCBI is working closely with the FAA, DoD, NASA and commercial trainers in an effort to develop national standards for the composites industry. Also, RCBI will expand the availability of all general training course offerings to each site. Individuals who complete any RCBI general training course are eligible for college credit.

During the term of this grant, RCBI reinstated its Manufacturing Engineering Program, a partnership program with the Marshall University Community & Technical College (MCTC), as well as prepared more than 500 courses that were offered to the general public or customized for individual companies.

Quality Certification developed and implemented registered quality systems for proper documentation to ensure effective suppliers. Beyond compliance or registration, RCBI recognized that manufacturers needed other tools to improve their processes and systems. Specific areas that RCBI covered included military specs (and those that cover automotive and aerospace industries); ISO 9001; ISO 14001 – Environmental (Green Manufacturing); QS-9000 and TS16949: 2002; AS9100; Lean Manufacturing; Six Sigma and Supervisory Management.

During the period of this grant, RCBI provided Quality implementation courses and assistance to more than 200 companies and worked with an additional 400 certified companies across the service region with updates, gap analyses, etc.

RCBI provided assistance to the West Virginia Army National Guard, which included ISO 9001 Quality Management; ISO 14001 Environmental Management; Six Sigma Green Belt; and Problem-Solving, Root Cause Analysis and Corrective Action Training.

Without Quality assistance from RCBI, including Six Sigma and ISO 9000, civilians serving in the military could not have refurbished military vehicles, including Humvees and transport equipment tires. This assistance was responsible for securing more than 125 civilian jobs with an estimated 100 additional trained staff planned in 2010. This skilled workforce enabled the Army National Guard to refurbish weapons platforms and Humvees, as well as recondition field service tools including fire extinguishers, tire jacks, shovels, hand tools and other accessories directly from the war theater, then re-issue them to military units stateside at a cost savings of 60 percent to the federal government. With networking assistance and manufacturer capability assessment from the RCBI 21ST Century Manufacturing Network

(www.21stmanufacturing.org), the West Virginia Army National Guard was able to locate quality-based and capable manufacturers to rebuild hydraulic jacks and support the overhaul of valves, spools, hoses and other tools.

A continuing – and expanded – highlight involved Kanawha Electric & Machine. This small company refurbishes generator motors that are being returned to Iraq. RCBI provided ISO 9000 Implementation and Documentation assistance to the manufacturer so it could become compliant and begin the registration process. The company, with RCBI assistance, follows the necessary military specs and requirements in the re-manufacturing process for the motors. The motors are being sent to Kanawha Electric from the Iraqi theater, refurbished at company's operations in Charleston, W. Va. then shipped back for the soldiers' operations. An additional element to this success story is the development of a portable compressor that supports pneumatic tools as well as deployment of and ease of use of disposable fuel cell bladders (for Humvees and other military vehicles including supply trucks). The first phase order of six prototypes, which were built, tested and have proven successful has progressed to a limited-rate-production milestone order of an additional 600 units. It is anticipated that this portable compressor has the potential benefit to the military to reach into the thousands of units of production and deployment.

RCBI provided training to 45 internal auditors in ISO 9001: 2000 Quality management systems requirements. Eighteen of the auditors were also trained in TS 16949: 2002 requirements for automotive production. RCBI assisted one organization in achieving ISO 9001: 2000 Quality Management System registration and another in achieving ISO 14001: 2004 Environmental Management System registration.

Because of Quality implementation assistance from RCBI, Aurora Flight Sciences of West Virginia, BF Goodrich, Bombardier, FMW Composite Systems, Inc., Level 1 Fasteners, Kanawha Electric, The National Biometrics Security Project, Pratt & Whitney Aircraft Services, Special Metals, Star Technologies and West Virginia Manufacturing Solutions, to name but a few, are registered to or compliant with various quality management systems that are required for them to remain DoD suppliers.

Information Technology in place at RCBI is designed to meet the electronic commerce needs that present unique opportunities to manufacturers. More than 400 manufacturing companies actively participate in the RCBI 21ST Century Manufacturing Network, a computerized clearinghouse that allows manufacturers to network with each other and reach new markets. The network allows participants to market, team, convert documents, electronically communicate via e-mail and conduct other collaborations on line. This effort enhances the strength of the electronic chain of DoD suppliers across West Virginia and the region.

THE RCBI 21ST CENTURY MANUFACTURING NETWORK

RCBI had a positive, measurable impact during the term of the grant with the RCBI 21ST Century Manufacturing Network (www.21stmanufacturing.org).

The RCBI 21ST Century Manufacturing Network supported procurement efforts to enhance West Virginia's DoD supplier base through access to electronic network parts catalogs, including the Defense Logistics Agency (DLA) as well as a variety of other DoD sourcing centers and prime contractors including TACOM, TROSCOM Cherry Point Naval Station, ASO, DLA, DSCC, FAA, FBA, the SBA Office of Technology, NASA, the Naval Electronic Warfare Center, Naval Facilities Engineering Command, PAX River Naval Air Station, the Army National Guard, DSCP, DSCC, the U.S. Corps of Engineers and the DoE. Through access to bid opportunities from these electronic resources, RCBI facilitated the existence of a quality, just-in-time, cost-effective, competitive, alternative, DoD supplier base. RCBI accomplished this task by providing technical information, reverse engineering assistance, digitization of blueprints, three-dimensional computer models and document bid technical packages on sole source DoD parts to interested manufacturing firms across the region. Participants in the RCBI electronic network continue to actively support DoD requirements.

Nearly 300 DoD and other government agency contract opportunities valued in excess of \$700 (M) million have been submitted by West Virginia manufacturers. The RCBI 21ST Century Manufacturing Network guided the companies and entrepreneurs to successfully bid on these contracts, which ranged from the manufacture of textiles, metals and electrical components to weapons components and spare and repair parts for military vehicles. The expanding list of contract recipients include Ashland Machine; Aurora Flight Sciences of W. Va.; Azimuth; Compton Metals; DeVall Brothers; Extreme Endeavors, Inc.; FMW Composite Systems Inc.; GPR Enterprises; Green Pack, Inc.; H & H Pallets; Huntington Plating, Inc.; Industrial Plating and Machine, Inc.; Industrial Rubber Products; Kanawha Electric & Machine; Lanny Williams, Inc.; Lenco Machine; Machine-Tech, Inc.; Meadow River Enterprises; Mustang Survival (formerly Wirt Survival, Inc.); Pressure Products; Quality Components; RF Manufacturing; Star Technologies; Stainless & Alloy Supply Company; Swanson Plating; TRAMCO Machine; Tri-State Roofing and Sheet Metal; Vintech; Walhonde Tool; and West Virginia Manufacturing Solutions, Inc.

Internally, to ensure better, more secure, cost-effective communications and linkages – and measurable results – between RCBI daily operations and the 21ST Century Manufacturing Network, RCBI implemented an electronic database, [SalesForce.com](https://www.salesforce.com), that integrated a real-time view of current RCBI client activity with potential on-line DoD contracting opportunities. In addition, during the period of this grant, RCBI implemented a new back-end, Coldfusion server with an upgraded SQL 2005 server. This technology allowed RCBI to automate much of the bid identification process so it was easily, regularly and readily available to manufacturers in the 21ST Century Manufacturing Network.

DOD SUPPLY CHAIN PROGRAM/BUSINESS DEVELOPMENT

RCBI continued to strengthen DoD supplier chains across the region by ensuring technical resources were available to meet industry requirements. This focus brought quality-based manufacturers together with appropriate DoD production, testing and prototype needs. RCBI's Business Development team efforts worked to identify and distribute government contracting opportunities to manufacturers across our service region. The focused experience provided by RCBI helped clients maintain sales quotas, generate business leads and properly manage their teams as valuable participants in the RCBI 21ST Century Manufacturing Network. RCBI's team assisted clients through DoD registration sites, coordinated workshops and maintained databases. RCBI positioned itself to work closely with the region's manufacturing sector to match the critical needs of DoD agencies and their primes to West Virginia manufacturers' technical abilities.

Participants in the RCBI 21ST Century Manufacturing Network offered production assistance for components of the Bombot, a cost-effective robot that disables and disposes of improvised explosive devices. From the manufacture of aluminum payload baskets to other basket mounts and components for the robotic units, RCBI assisted to ensure that quality companies across the state and region were directly involved in supporting military requirements that help keep U.S. forces in Iraq and Afghanistan out of harm's way.

A few examples of RCBI's Business Development occurred during the period of this grant are:

RCBI assisted with prototyping of a West Virginia's manufacturer's capability to supply the U.S. military with advanced Biometrics technology. RCBI facilitated a DoD prime contractor's use of a north-central West Virginia manufacturer to produce a composites casing with advanced electronic hardware and software for face recognition, fingerprint, dentex, vision, voice recognition and SmartCard applications.

RCBI offered *Introduction to Biometrics* training sessions, in partnership with the National Biometric Security Project, for industrial settings, power generation plants and related organizations that needed to incorporate the role of Biometrics for security and identification.

RCBI successfully fulfilled DoD obligations and expanded support to ongoing military operations in Iraq with a Biometrics identification security checkpoint device and to the U.S. National Guard with distance learning opportunities to develop and strengthen the DoD supplier base in this region. The Biometrics checkpoint device was flown on C-17s from Yeager Airport in Charleston, W.Va, to Baghdad, Iraq. The

contract, worth in excess of \$10 (M) million, was produced for the Marine Corps' Special Operations by RCBI 21ST Century Manufacturing Network participant, Azimuth Inc. of Morgantown, West Virginia. RCBI assisted the prime (Azimuth) in identification of materials, components and small, veteran-owned machine shops across West Virginia.

A supply of electronic communications circuit boards was secured and supplied for DoD agencies, including the U.S. Army, as a result of Business Development involving quality initiatives. Superior Manufacturing Services in Beaver, W. Va., needed internal auditor assistance and training to satisfy ISO 9000 requirements. The manufacturer turned to RCBI for help and the result was a successful contract for the communications equipment.

RCBI successfully coordinated the first-signed-in-West-Virginia NASA Space Act Agreement with private industry. The NASA Langley Research Center signed the agreement with Extreme Endeavors Consulting of Philippi for an extreme low frequency acoustic measurement system to be deployed in cave surveillance. This effort expanded to test case scenario and was deployed by the National Guard for training active military personnel. The system offered the potential to be used overseas in numerous remote areas in the Mid-East theater to support our nation's homeland security initiatives.

RCBI expanded the technological capabilities in Science and Technology through partnership with the NASA Goddard Space Flight Center. More than \$20 (M) million in government contracts were awarded to West Virginia manufacturing and fabrication companies. One southern West Virginia machine shop, that is ISO 9000 certified, was added to the approved vendor list to supply metal-machined components to NASA. This vendor is capable of precision machining and fabricating space flight-critical hardware. Another West Virginia manufacturer, FMW Composite Systems Inc., completed work on several contracts from the NASA Goddard Space Flight Center to manufacture space optical bench components as well received an R & D opportunity to design, develop and produce a prototype Super Lightweight Interchangeable Carrier (SLIC) pallet through a multi-phase contract.

With RCBI support of quality and engineering requirements as well as for CAD/CAM software and programming aspects, regional manufacturers were able to produce titanium matrix component materials (TMC) for aircraft landing gear for the Joint Strike Fighter and brake rods for (commercial aviation) Boeing 777 and 787. As a result of this type of RCBI technology assistance, Airbus S.A.S. contracted with FMW Composite Systems Inc. of Bridgeport, West Virginia, to produce brake rods for its Airbus A340, and expanded FMW capabilities to support aerospace shuttle-related missions. RCBI provided technical training in proper hand lay-ups and the curing process of advanced composites materials for the Global Hawk UAV and multiple machining and programming operations. Because of the successful deployment of the TMC materials for the Airbus A340, FMW Composite has begun company expansion efforts that include building a new production facility. This expansion involves a high-pressure, intense heat material-curing technology. The effort further impacted the regional economy with construction of a 50,000-square-foot facility, where in the first year a phased-in employment approach created 12 additional production jobs.

RCBI provided access to cutting edge technologies as well as assisted in the development and fabrication of new and advanced composites materials for DoD and NASA needs. With expansion into the composites and advanced materials production markets, RCBI became the the East Coast's Regional Technology Center for Advanced Composites Production and Training. The Composites Center provided technical training and technical assistance opportunities to 152 manufacturers. In addition, the Composites Center provided technical training to more than 1,179 individuals representing nearly 76 regional companies from the titanium metal matrix composite; filament winding; carbon fiber; glass filament; high-end plastics; high-end fiber glass cloth; kevlar material; ceramics; aluminum honeycomb; Dynel fabric; coal foam; wood; and rubber compound sectors. Expansion and diversification into composites catapulted a 600 percent growth in the market for the region.

To further expand access to new technologies and comply with more stringent defense requirements, RCBI provided enhanced engineering support with installation and use of Mastercam, SURFCAM, GibbsCAM, Esprit, FeatureCAM, AutoCAD, Autodesk Inventor, and SolidWorks software capabilities.

These software capabilities enhance the required tolerance targets and strict quality compliance. In addition to technology software access, RCBI provided the only hands-on AutoCAD, Autodesk Inventor, SolidWorks, Mastercam and FARO Arm's CAM2 software training courses across the region.

RCBI assistance extended into the eastern panhandle of West Virginia as well as through the Maryland area with support to businesses that provided manufacturing services as part of an Indefinite-Delivery, Indefinite-Quantity contract for NASA. The contract, which ran three years, was successfully completed. It involved the manufacture of fabricated items and engineering services for government machined-prototypes that were utilized for form, fit & functional models. The models were used to verify that the proposed design could be properly assembled with the other components. RCBI assisted in CAD/CAM software development and, in turn, the manufacture of accurate models, which allowed engineers to verify the design for initial assembly as well as for disassembly and maintenance. RCBI's continuous support & assistance was required for these contracting opportunities to ensure cost-effectiveness and manufacturability, so design changes were possible prior to the final manufacture of metal components by participants in the RCBI 21ST Century Manufacturing Network. The critical components were produced from common & exotic advanced materials such as stainless steel and aluminum as well as titanium, invar, inconel, delrin and other exotic metals that were often engineered and produced for use in military operations and our nation's Space program.

West Virginia manufacturers, Aurora Flight Sciences of West Virginia, Alliant Techsystems, Azimuth Incorporated, Bombardier, Eagle Glass and FMW Composite Systems Inc. and Kvaerner Power, earned contracts valued in the millions of dollars to manufacture metal and composite components (including sight glass components; DoD Biometrics components; aviation nose cone retrofits; the Wing, Aft V-tail Wing and Fuselage for the Global Hawk UAV as well as enhanced ground-to-air and air-to-air weapons systems and aircraft landing gear for the Joint Strike Fighter.) To design, develop and manufacture critical components in a quality, timely manner, regional manufacturers utilized fabrication and machining services for metals and composites-manufacturing needs at the RCBI Bridgeport facility. Advanced machinist skills training, undertaken at Rocket Center for Alliant Techsystems, ensured that its employees were diversified to undertake specialized workforce development initiatives that are critical to the nation's homeland security. RCBI provided training to the members of the first line Composites team involving a Navy-owned cop-op, so that they could fulfill their role in the Global Hawk programs as well as continue to bid on additional enhanced weapons systems.

RCBI had positive, measurable impacts during the term of the grant in Distance Learning Tools and partnered with national providers such as ToolingU to provide direct access to more than 400 expanded on-line topics that range in content from training machine operators, welders, assemblers, inspectors and maintenance professionals. This online technology expanded the reach of training initiatives available to further the mission of meeting critical federal and state DoD requirements. In addition, RCBI's own integrated distance learning system allowed instructors to originate training programs from any area of the service region and reach well beyond the primary RCBI service region.

The RCBI Quality group continued to work with the region's small manufacturers who are or may be interested in bidding on contracts to manufacture products for the DoD and NASA. RCBI's program remains flexible and customized to take the manufacturer to the desired level of certification in – or compliance with – appropriate ISO, AS or QS standards. Across the region RCBI identified 400 certified companies that are capable of assisting the DoD. Quality assistance continues by providing companies with documented quality management systems and recognized management skills.

Workforce development courses covering customized AutoCAD, Inventor, Mastercam, Pro Engineer, Solid Edge and SurfCAM software training were delivered to BF Goodrich, Bayer Crop Science, Dominion Transmission Inc., Engines Inc., Innovative Screen Technology, Kenny's Machine Service, Lenco, Northrop Grumman, Pratt-Whitney, Pressure Products, UCAR Carbon and other West Virginia manufacturers. The courses provided an overview of Basic AutoCAD principles and uses that focused on -- and met -- critical needs across the aerospace industry. Composites and Lean Manufacturing courses were delivered to Lockheed Martin, Bombardier, Blackheart Industries, FMW Composite Systems, KCI Aviation, Kvaerner Power, the NASA Marshall Space Flight Center in Huntsville, Ala., Sino Swearingen,

Alliant Techsystems, Eagle Glass Specialties, Inc., Aurora Flight Sciences of West Virginia, UCAR Carbon/GRAFTech, the West Virginia Air National Guard and more than a dozen other companies across the region.

Specific examples of RCBI's DoD-directed technical assistance projects include:

- Provided software engineering and programming assistance, workforce training and access to RCBI's McClean Anderson WSH Flex Filament Winder technology to Williams International, a composites manufacturer to produce a carbon fiber cylindrical casing for a DoD classified weapons platform.
- Assisted Azimuth Incorporated of Morgantown, West Virginia, with the manufacture and on-site guidance for installation of the first prototype carbon-fiber laminate sheet-console panel on the marine vessel USNS Guardian, operated by the Combatant Craft Division (CCD) of the Naval Surface Warfare Center's Carderock Division (NSWCCD) in Potomac, Maryland.
- Assisted Kanawha Electric & Machine with design and development of portable compressor units for use by military in the field of operations to support Humvees and other military vehicles. Further, RCBI assisted with initial manufacture of aluminum-tubing components as well as the frame for portable compressor units.
- Leased production time on RCBI's Northwood 5-axis CNC Router, and provided technical expertise, to Aurora Flight Sciences of West Virginia to manufacture composite doors for the Sikorsky MH53 transport helicopter for U.S. Marine Corps use.
- Provided ISO 9000 Implementation and Documentation assistance to Kanawha Electric & Machine so the Kanawha County manufacturer could refurbish generator motors for military operations in Iraq.
- Provided Certified Soldering Training to Alliant Techsystems.
- Assisted Aurora Flight Sciences of West Virginia with prototyping of sono-buoy launchers for Sikorsky helicopters division requirements from the U.S. Navy.
- Assisted Aurora Flight Sciences with chaff dispenser composite units to reduce helicopter weight and enhance corrosion resistance for the U.S. Army.
- Assisted Touchstone Research Laboratory with Shared Manufacturing support (on the newly-retrofitted 6-axis) and Mastercam training to complete component parts for DoD applications, including parts for Sikorsky Aircraft's Black Hawk program.
- Assisted Compton Metals of Clarksburg with SurfCAM software training and CNC production capabilities, which enabled the Harrison County manufacturer to support BISA, the Biometric Identification System for Access. This DoD project enhanced military force protection initiatives for U.S. installations in Iraq and other hostile theater environments.
- Continued Shared Manufacturing support and technical assistance (ranging from engineering assistance, production preparation, manufacturing and critical inspection of components) to Aurora Flight Sciences of West Virginia, which manufactured a prototype of aircraft wing molds for the Global Hawk UAV (Unmanned Aerial Vehicle). Without access to the niche technologies offered at RCBI, specifically the 6-axis Machining Center at RCBI Bridgeport, the manufacturer would not have been able to even submit a cost-effective proposal to perform this work. Further, RCBI provided CMM and FARO Arm assistance for digitization and verification of production dimensions to ensure the components met U.S. Air Force requirements.
- Provided access to computer-controlled production equipment to manufacturers including Azimuth, Compton Metals, Kanawha Manufacturing and Kvaerner Power for military robots.
- Provided bid proposal development and fabrication/machine rate cycle time projection assistance to Terramite Corp. for a contract to manufacture robotic loader/backhoe that met military needs.
- Assisted Extreme Endeavors of Philippi with an agreement to develop innovative cave monitoring technology involving acoustics that had DoD applications and uses.
- Provided quality training to Superior Manufacturing Services, which enabled the company to qualify to supply electronic circuit boards to DoD agencies including the U.S. Army.
- Provided Blackheart International with CNC production capabilities as well as technical production assistance in the manufacture of AK-47 assault rifle barrel parts for the U.S. military.

- Identified and tested manufacturing techniques for Kvaerner Power to produce robotic parts for DoD use. The robotic design disabled and disposed of explosive devices in combat or hostile environments without exposing its operator to danger. RCBI provided prototyping assistance and reverse engineering (using a FARO Arm) as well as CNC machining of various robotic parts. RCBI assisted in the identification of West Virginia manufacturers (through the 21ST Century Manufacturing Network) that were capable of supplying components for the robot.
- Leased production time on the Amada Pulsar 1212XL 2000-watt Laser Cutter and Okuma "CADET" BB CNC Turning Center to Star Technologies for manufacture of steel pieces for Abrams tank and alloy-component washers for G. E. aircraft engines.
- Assisted FMW Composite Systems Inc. with quality and engineering requirements as well as CAD/CAM software and programming assistance that enabled the manufacturer to produce titanium matrix components for aircraft landing gear for the Joint Strike Fighter and brake rods for (commercial aviation) Boeing 777s.
- Assisted Azimuth Inc. with CAD/CAM, prototyping, Shared Manufacturing and production of aluminum lids and cabinets for hand held computer cases for the U.S. Navy.
- Assisted Mustang Survival with bid preparation for contract to manufacture air crewmen survival rafts, military-issue flotation devices as well as other life-saving garments and equipment for DoD uses. All branches of the U.S. military have long used Mustang Survival products, which offer superior safety solutions – on, over and in the water; for aviators and ground forces. With the ongoing assistance of RCBI, the company's West Virginia plant secured a series of continuing DoD contracts.
- Assisted FMW Composite Systems Inc. with Shared Manufacturing and CNC production of fuel cell bladder components for the U.S. Marine Corps. As a result, the production was done in West Virginia at the RCBI Bridgeport facility with a reduction in costs conservatively placed at 30 percent for the U.S. Marine Corps.
- Assisted FMW Composite Systems Inc. with Shared Manufacturing of full-rate production of titanium matrix-based composite-components for the Joint Strike Fighter for U.S. Air Force and Navy requirements.
- Assisted Garrett Container Systems with prototype assistance for DoD shipping containers.
- Assisted Greater Maryland Tool with Shared Manufacturing and CNC production of stainless steel and exotic metal socket head cap screws, sockets, studs and worm drive parts used in U.S. Navy nuclear vessels.
- Assisted Industrial Rubber Products with bid preparation for the manufacture of spray nozzles with a variable orifice flow rate with 20 gpm and 50 psig in its range. The nozzles were used in federal laboratories.
- Assisted Mineral Fabrication & Machine Co. with Shared Manufacturing and CNC production of aluminum components for the Hubble Space Telescope and other replaceable tooling parts.
- Assisted CM&M Development with preparation of five bids for the manufacture of parts (Back Plate Latches and Front-Sight Blades) for the M240 machine gun, Machine Keys for the 155MM Howitzer and Feed Shaft Assemblies for the M242 Gun used in Bradley Fighting Vehicle System.
- Assisted Lenco Machine with bid preparation to manufacture electrical jackscrews for the M1A1 Tank.
- Assisted Ashland Machine with bid preparation to manufacture barrel nuts for small arms weapons for the U.S. military.
- Assisted D & E Industries with bid preparation to manufacture handles for the M198 Towed Howitzer.
- Assisted DeVall Brothers with bid preparation to manufacture spare and repair parts for the Defense Supply Center Columbus.
- Assisted ATK with technical training needs to meet both metals and composites manufacturing needs for the Global Hawk UAV.
- Assisted FMW Composite Systems Inc. with bidding, quality and technical assistance with production of the Global Hawk UAV.
- Assisted the DoD Biometrics Management Office with destructive testing.

- Assisted Swanson Plating with technical assistance and machining capabilities to support a major defense contractor. This assistance resulted in development of a new company in the region, and added 25 jobs to the region's contingent of skilled workers.

ROBERT C. BYRD INSTITUTE

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TECHNOLOGY TRANSFER EFFORTS

A key component Technical Services at RCBI involves manufacturers' access to state-of-the-market manufacturing equipment that otherwise wouldn't be available to them because of its prohibitive expense. Manufacturers across the state and throughout our service region have invested in state-of-the-market manufacturing equipment, both hardware and software, as a result of exposure to and trial use of these types of state-of-the-art and -market, computer-controlled, production equipment available for leased use at RCBI.

More than 180 pieces of computer-controlled manufacturing equipment (including lathes, mills, wire EDMs and water-jet cutters) have been purchased by private industry after initial exposure and access at RCBI Advanced Manufacturing Technology Centers. This Technology Transfer effort represents an investment in excess of \$26 (M) million by private industry.



ROBERT C. BYRD INSTITUTE

1050 Fourth Avenue
Huntington, WV 25701



June 29, 2010

Defense Technical Information Center
ATTN: BCS
8725 John J Kingman Road, Suite 0944
Ft. Belvoir VA 22060-0944

RE: Grant Number: MDA972-02-1-0018 Final Technical Report

The Robert C Byrd Institute for Advanced Flexible Manufacturing is pleased to submit the attached final technical report for Grant Number MDA972-02-1-0018.

If you have any questions, don't hesitate to contact me at 304.781.1655 or cweber @rcbi.org.

Sincerely,

A handwritten signature in cursive script that reads "Charlotte Weber".

Charlotte Weber
Director & C.E.O./Principal Investigator